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BATHYMETRY FOR PROPAGATION RUNS ON PROJECT EARS CRUISE 1.(U)  
JUL 67 R B MACDONALD

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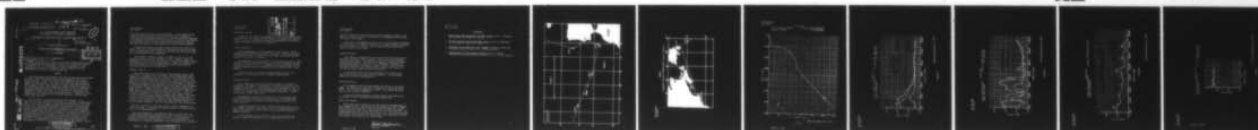
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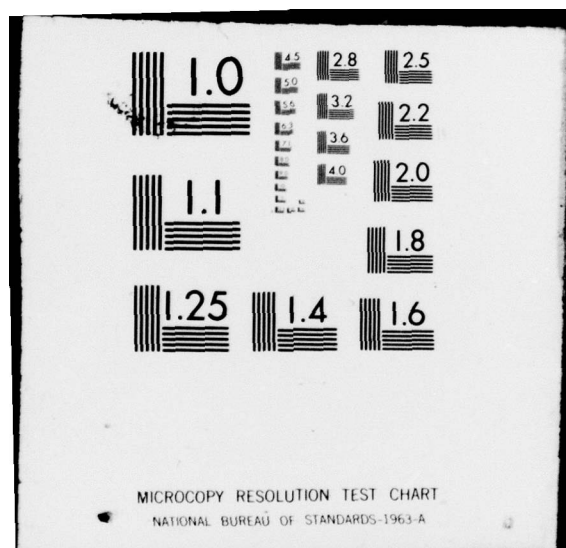
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U. S. NAVY UNDERWATER SOUND LABORATORY  
FORT TRUMBULL, NEW LONDON, CONNECTICUT

BATHYMETRY FOR PROPAGATION RUNS ON PROJECT EARS CRUISE 1.

by

USL Problem  
No. 8-1-401-00-00

Robert B. MacDonald

USL Technical Memorandum No. 2211-97-67

31 July 1967

INTRODUCTION

This is the third in a series of technical memoranda dealing with data obtained during Project EARS, Cruise 1 in the period 28 October - 13 December 1966. The bathymetric information contained in this memorandum will be used in conjunction with propagation loss and reverberation studies of the EARS program.

## RESULTS

The bottom profiles contained herein were plotted from data recorded aboard the USNS LYNCH (AGOR-7) during each propagation run at each acoustic station. A Westrex Precision Depth Recorder was employed to obtain the bottom traces. The traces were reduced by hand and bottom depths tabulated with time. The time of closest approach of LYNCH to the receiving platform (USNS SANDS) was equated to the zero range point. All other range points were calculated acoustically from travel time measurements between the ships. No corrections have been applied to compensate for the drift of the receiving platform. A maximum of three runs/station were completed with the LYNCH opening or closing range on the SANDS position.

From the time vs. range plots reported in reference (1), a tabulation of time, range and bottom depth was compiled. An IBM Program (0918) was written to compute a slope and velocity correction for each bottom point. Harmonic Mean Velocities were computed for each station from the velocity profiles reported in reference (2). The difference between the standard 4800 ft/sec incorporated in the Westrex Recorder and the harmonic mean velocity calculated from the velocity profile for a given depth was used to correct the depth. The equation for the slope correcting portion of the program (from reference 3) proved to be too simplified and led to many erroneous values in the resulting bottom profiles. A re-examination of the Westrex traces indicated that the high degree of variability in bottom shape did not lend itself to any of

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USL Tech Memo  
2211-97-67

the known simplified slope correcting methods. A more sophisticated slope correcting procedure, such as that outlined in reference 4, could have been employed successfully, but the time and effort required to accomplish the corrections for all the runs could not be justified by the information gain. For that reason, the bottom profiles reported here have been velocity corrected but have not been slope corrected.

Program 0918 outputs the harmonic mean velocity as a function of depth, the velocity corrected depth as a function of time and of range, and a CalComp plotter tape. The plots resulting from the CalComp tape are those reported in this memorandum.

The position, direction, length and number of runs for all the acoustic stations are shown in Figures 1 and 2. Figure 1 gives the geographic locations of all the deep water stations while Figure 2 gives the locations of the shallow water stations. Figures 3 through 8 are the bottom profiles. A brief description of each station and the associated bottom profile is given below.

#### STATION 1 (Fig. 3)

The start position of this station lies almost due west of Cape Finisterre on the west coast of Portugal. The original intent was to commence the propagation runs over the peak of the underwater terrace area known as Galicia Bank and run due south. The water depth on the peak is as shallow as 1800 feet but drops off rapidly in all directions. Because of the high sea state and drift rate of the SANDS on station, the opening propagation run commenced at a point west of the prearranged start position; in about 8000 feet of water. The LYNCH opened range along 180°T to 117.2Kys relative to SANDS and then closed range on the SANDS completing the two propagation runs shown in Fig. 1. Only one bottom profile appears in Fig. 3 for Station 1 and it is shown as a dotted line except for the interval between 96 and 105Kys. The reason for this is that the Westrex Recorder aboard LYNCH was inoperative except for the brief interval shown as a solid curve and that for this station, it was necessary to utilize H.O. 6750-6 (English Channel to Canary Islands) bathymetric chart for the majority of the bottom profile.

Note that the vertical scale used in Fig 3 tends to exaggerate the slope of the bank. In reality, the general slope of the bottom over the entire run is approximately 1°.

The bottom sediment on the bank was found to be coral rock. An extremely hard sandy clay was deposited on the slope and a soft silty clay was found at the maximum range of the run. A more detailed analysis of the nature and composition of the bottom materials will be forthcoming in a technical memorandum on the core analysis from Code 2213.

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Station #2 (No Fig)

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Station #2 was originally intended to be held in the Iberian Basin. Upon arrival at the station location however, the weather was found to be too severe to perform any propagation measurements and after 48 hours in the area, the station was cancelled.

Station #3 (Fig 4)

Three propagation runs were completed at this station. Run #1 opened range from SANDS along 220°T to 119.4Kys. Run #2 closed range on SANDS along 040°T. Run #3 opened range again on the same bearing as Run #1 to a range of 61.3Kys.

The agreement in bottom profiles for the three runs is good. After 60 Kys, the bottom becomes practically flat and the agreement between the runs is excellent. From 0 to 60Kys, the rise associated with the Gilbralter plateau region is evidenced and the agreement here is less perfect.

At this station, the bottom at maximum range was found to be composed of a silty clay with some calcareous ooze present.

Station #4 (Fig 5)

This station was held about 200 miles southeast of Terceira in the Azores. The region is classified as the Azores Rise and has quite a rugged bottom terrain. Three propagation runs were made at this station with the first and third opening range from SANDS on a bearing of 287° to a maximum range of 120 and 28Kys, respectively. Run #2 closed range on SANDS along 107°T.

The agreement between runs is quite poor. The rapidly varying bottom prominances coupled with high drift rates for the SANDS and rough seas combined to produce the observed dissimilarities in the bottom profiles.

The Westrex Recorder was again inoperative during transit of the first 22Kys of Run #1. Any attempt to fill in the missing portion of Run #1 from bathymetric charts of the area would produce results of doubtful validity.

No core information was obtained at this station and NODC was unable to supply any information in the immediate vicinity of the

USL Tech Memo  
2211-97-67

station. From the bottom profiles and other bathymetric charts of the area, the evidence indicates a hard bottom of predominately rock, sand, and clay in this region.

Here again the exaggerated vertical scale is particularly misleading at first glance. For example, the slope at a range of 55Kys in the plot for Run #1 amounts to about  $17^\circ$  while the curve itself as plotted is almost vertical at that range.

#### Station #5 (Fig 6)

The originally intended start position of this station was west of the station position actually occupied. Weather was the determining factor for this change. The station was held upon reaching the edge of the Newfoundland Basin. One long run of 280Kys was completed with LYNCH opening range from SANDS on a course of  $288^\circ\text{T}$ . Since this was the edge of the Basin, the terrain shows a gradual depth increase as the ship proceeded toward the Central Basin area.

At the start of the run, the bottom material was found to be a very hard sand mixed with chalk and small pebbles. At the maximum range, soft, sandy silt predominated.

#### Station #6 (Fig 7)

Two propagation runs were made during this station on the Grand Banks. An opening run along  $270^\circ\text{T}$  to 36Kys and a closing run along  $090^\circ\text{T}$ . With a vertical exaggeration of 200:1, the station #6 bottom profiles show excellent agreement.

A very hard bottom consisting of shell, gravel, and quartz sand was present at both the maximum and minimum range points.

#### Station #7 (Fig #8)

This shallow water station in the Gulf of Maine consisted again of two propagation runs. The opening run from SANDS along  $235^\circ\text{T}$  to 33Kys and a closing run along  $055^\circ\text{T}$ . The two tracks ran across the trough through which the waters of the Gulf empty into the North Atlantic. The track repeatability was good for this station also. The bottom consisted of very soft clay-silt with very little sand at the beginning of the run and a harder, more sandy silt at maximum range.

Robert B. MacDonald  
Robert B. MacDonald  
Physicist

USL Tech Memo  
No. 2211-97-67

#### REFERENCES

1. Range Versus Time Calculation for EARS, Cruise 1 by A. C. Vasiloff,  
USL Tech Memo 2211-70-67 of 12 Jun 67.
2. Velocity Profiles from Project EARS, Cruise 1 by R. B. MacDonald,  
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3. Bathymetry of the Gibbs Hill Area, Bermuda by Northrop, Blaik and  
Frassetto, Deep-Sea Research, Vol. 5 1959 pp 290-296.
4. Interpretation of Echo Sounding Profiles by Dale C. Krause,  
International Hydrographic Review, Vol.39, No. 1 of Jan 62, pp65-122.

FIGURE 1

Geographic Location of Deep Water Acoustic Stations

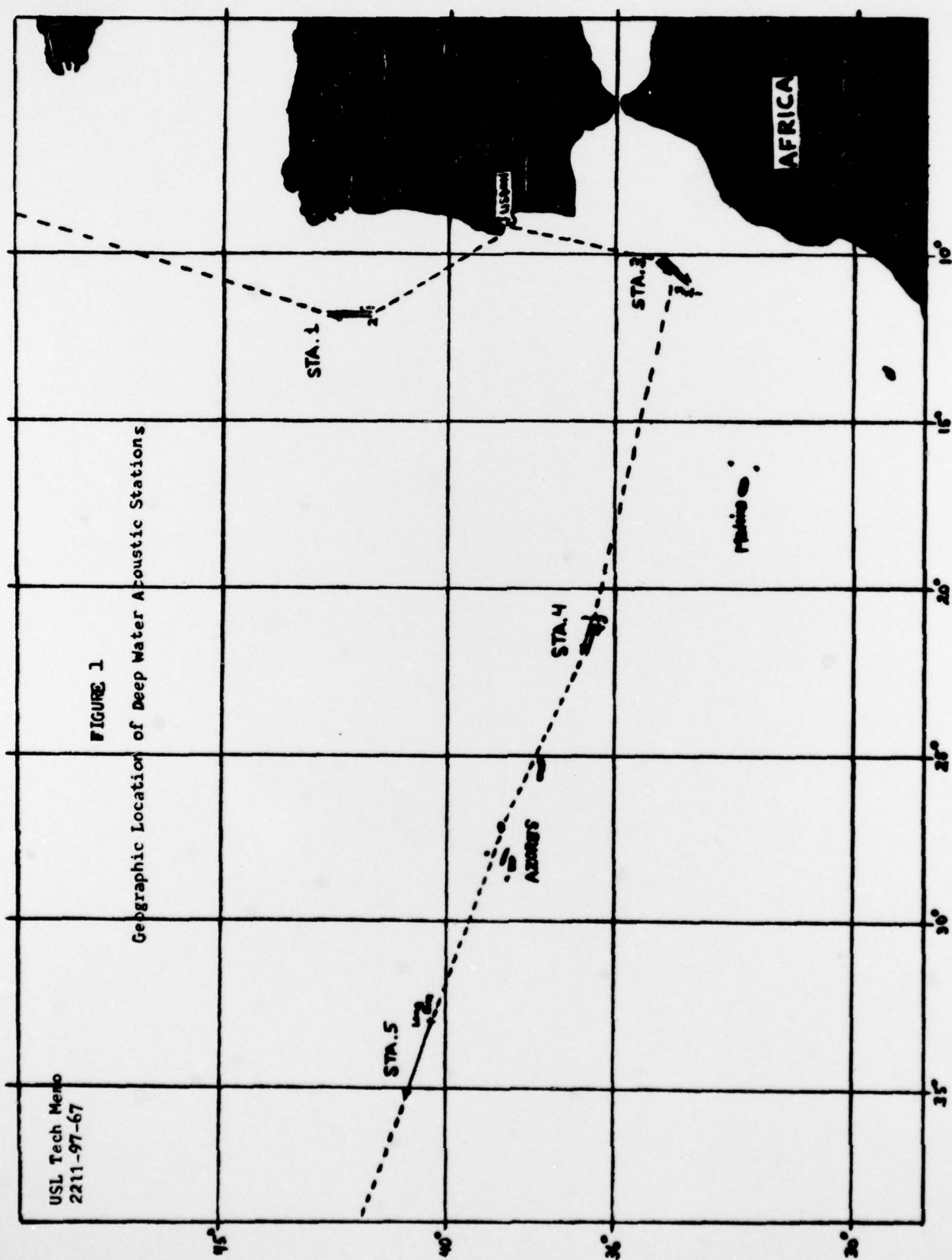
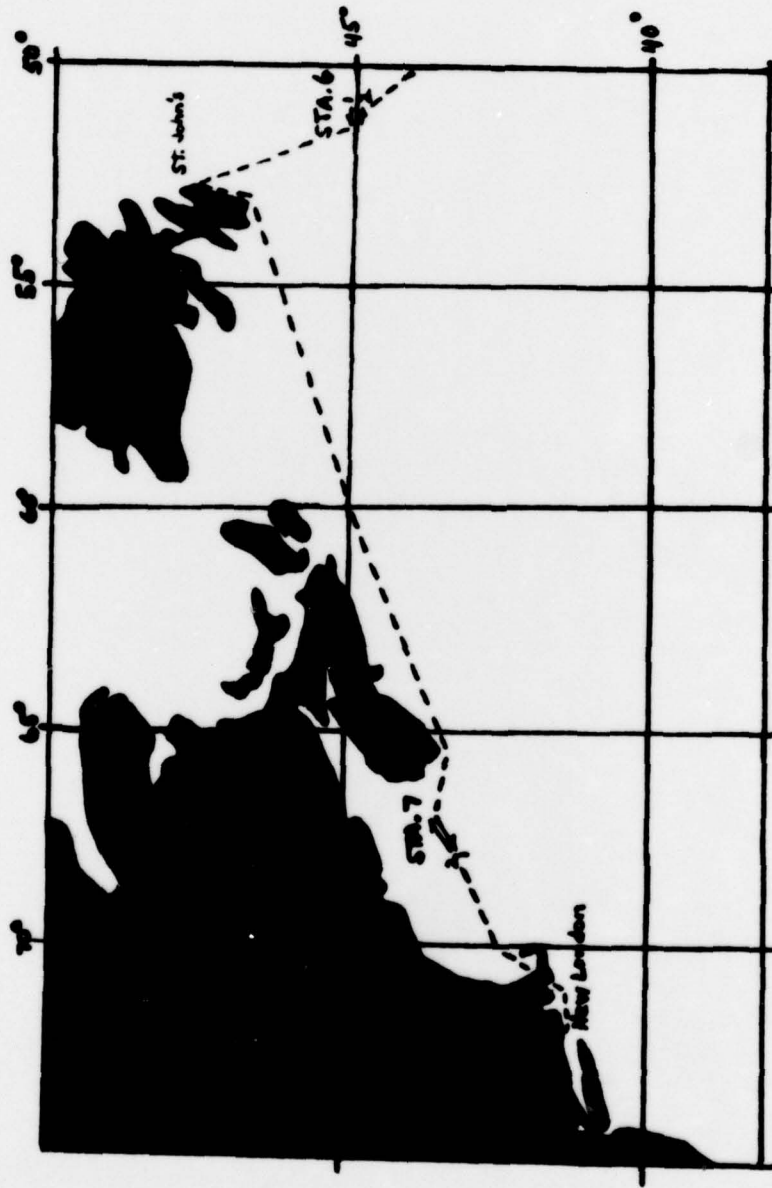


FIGURE 2  
Geographic Location of Shallow Water Acoustic Stations

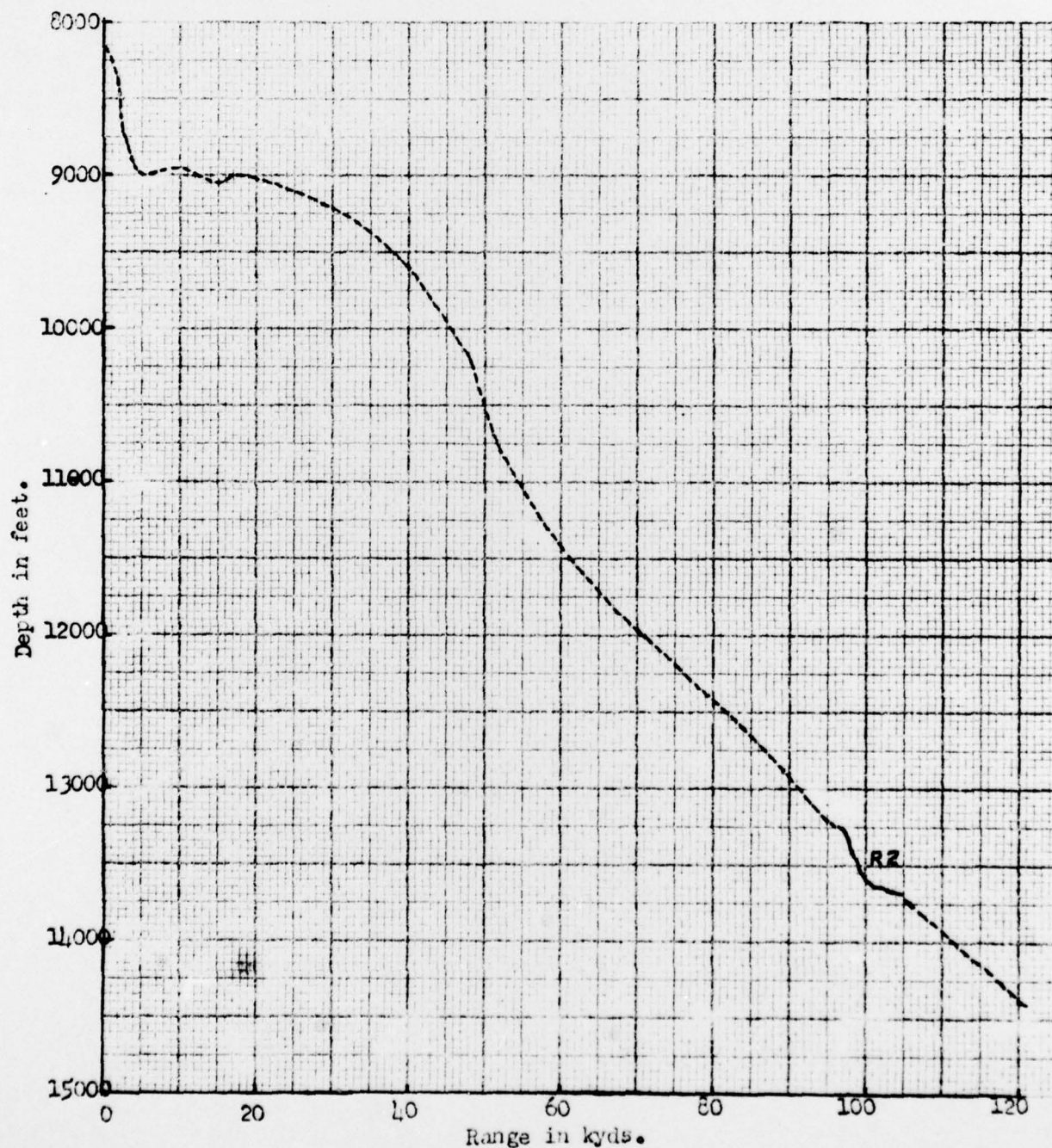


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2211-97-67

Posit: 42°42' N, 11°42' W  
Dates: 11/1-3/66

STATION #1

Course: 180° T (Opening)  
0° T (Closing)

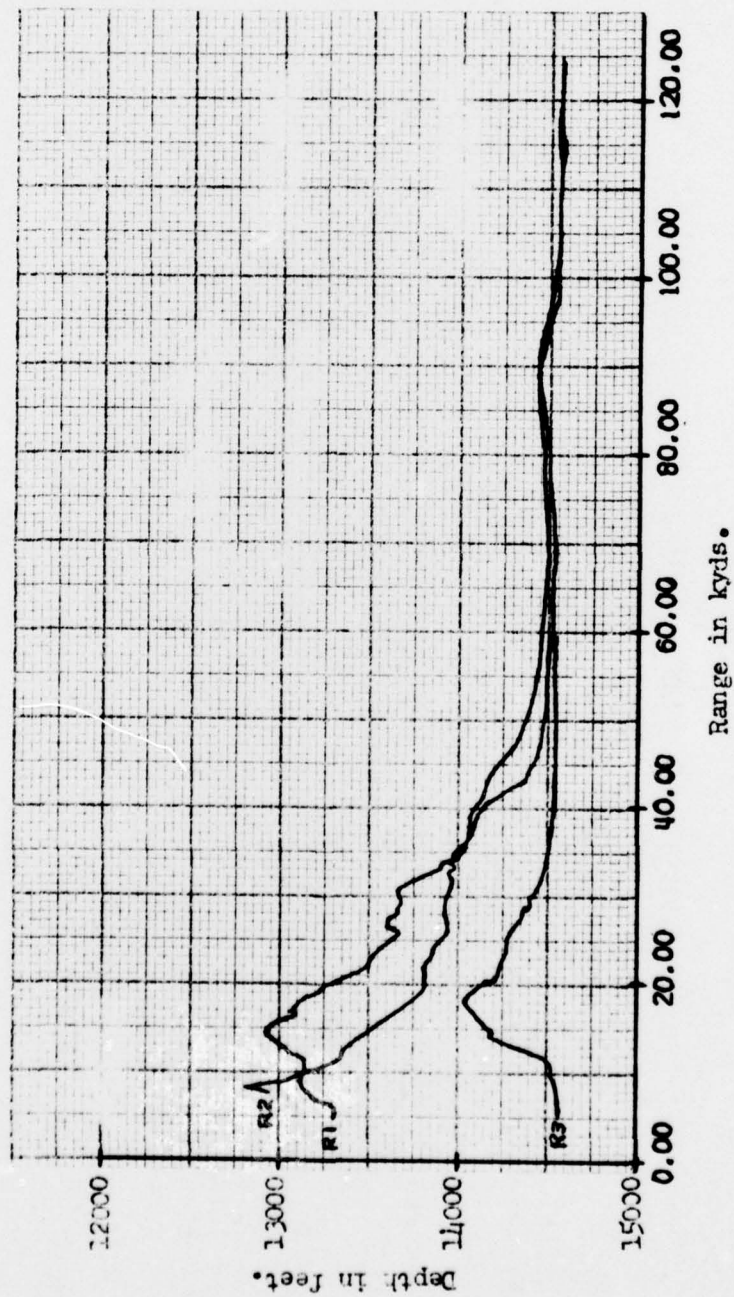


Vertical Exaggeration: 60:1

FIGURE #3

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Posit:  $31^{\circ}52'N, 10^{\circ}5'W$  STATION #3  
Course:  $220^{\circ}T$  (Opening)  
Dates: 11/14-15/66  $40^{\circ}T$  (Closing)

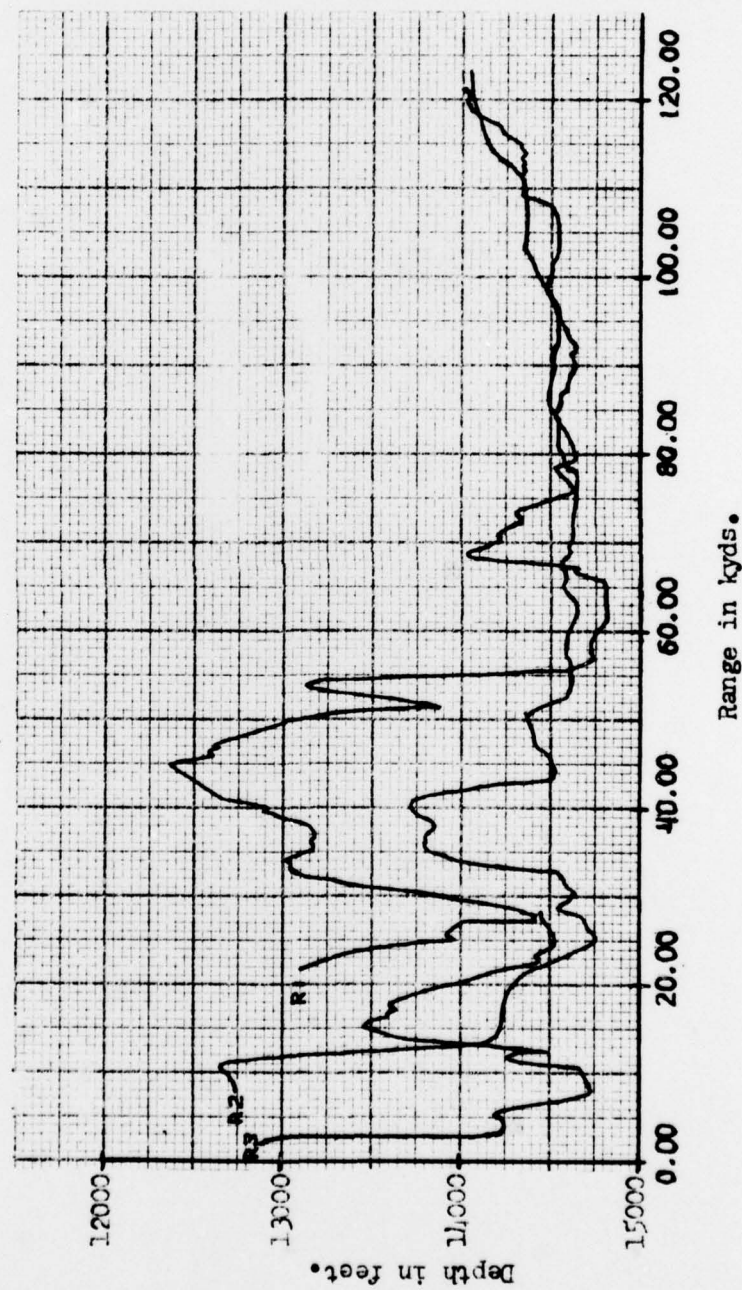


Vertical Exaggeration : 60:1

FIGURE #4

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Posit: 36°35'N, 21°0'W  
Dates: 11/19-20/66  
STATION #4 Course: 267°T (Opening)  
107°T (Closing)



Vertical Exaggeration : 60:1

FIGURE #5

Posit: 40° 24' N, 32° 51' W  
Dates: 11/28-30/66  
STATION #5  
Course: 260° T (Opening Only)

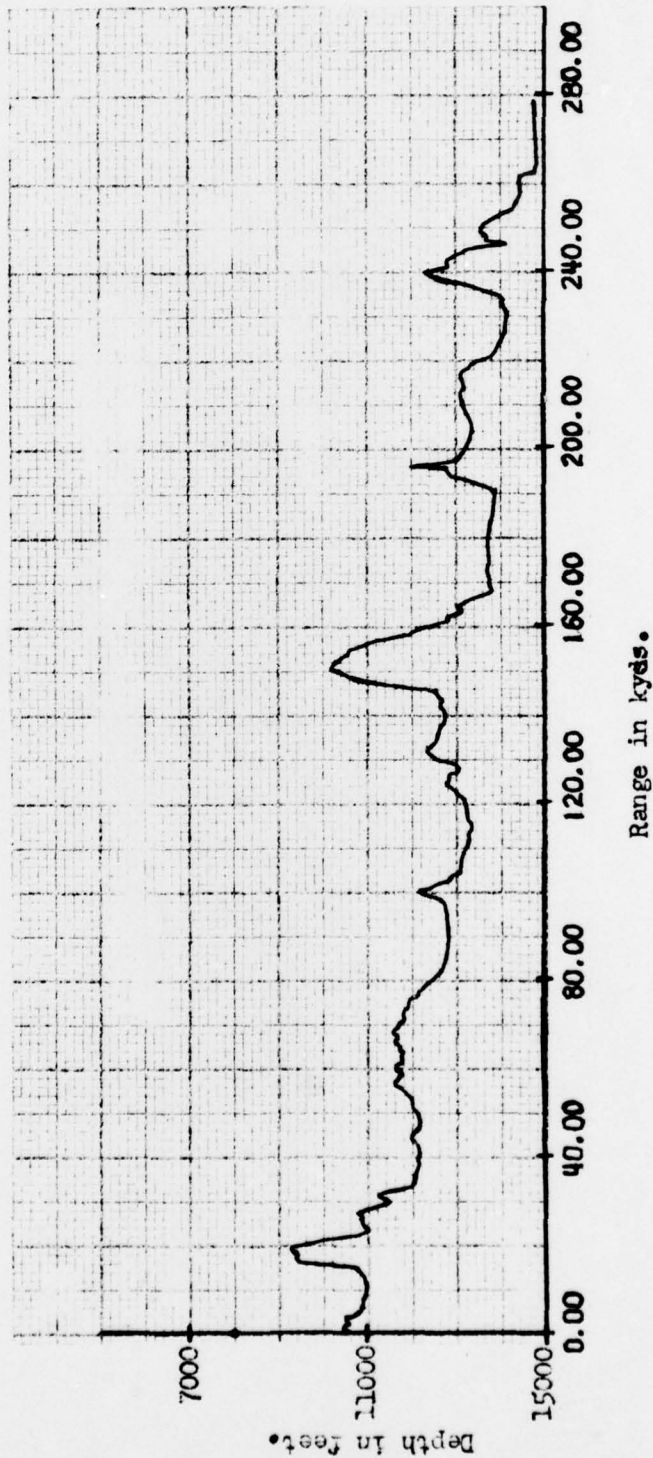


FIGURE #6

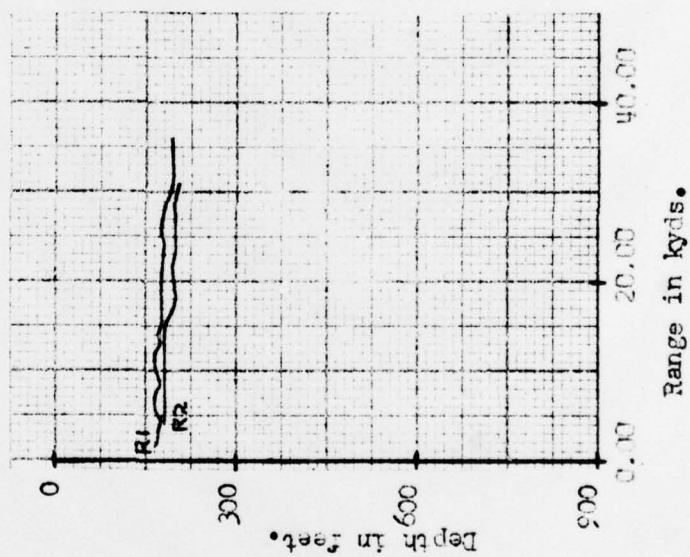
Vertical Exaggeration : 30:1

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Posit: 45°0'N, 51°0'W  
Date: 11/4/66  
Course: 270°T (Opening)  
90°T (Closing)

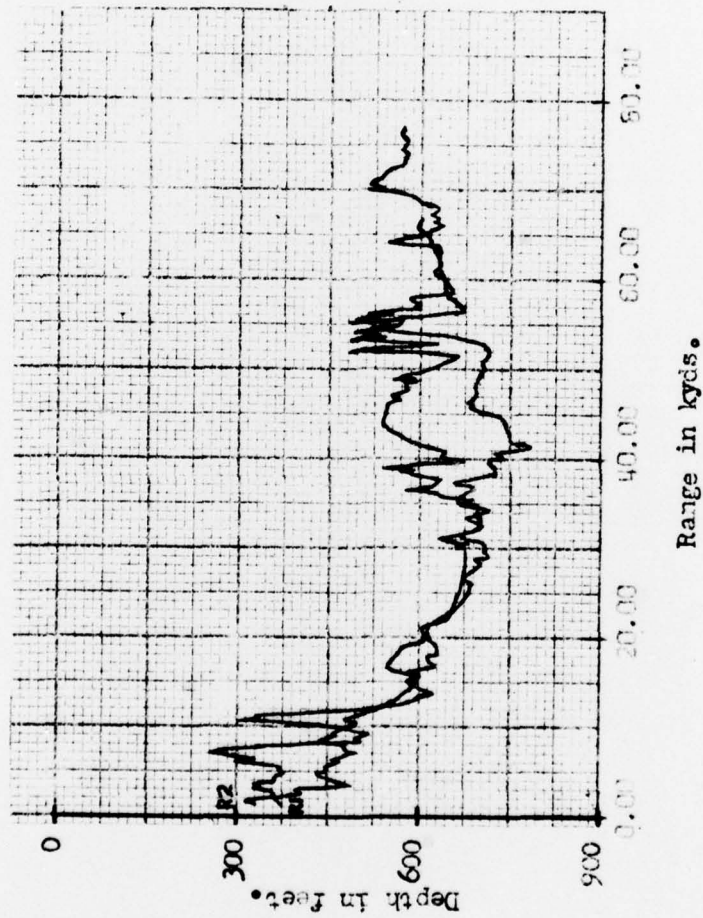
STATION #6



Vertical Exaggeration : 200:1

FIGURE #7

STATION #7  
Posit: 43°30'N, 67°0'W Course: 235°T (Opening)  
Dates: 11/11-12/66 55°T (Closing)



Vertical Exaggeration : 200:1

FIGURE #8